



## DEPARTMENT OF ENERGY

### Request for Information: Access to Quantum Systems

**AGENCY:** Office of Science, Department of Energy (DOE).

**ACTION:** Request for information (RFI).

**SUMMARY:** Congress has requested DOE to develop a roadmap to provide researchers access to quantum systems so as to enhance the U.S. quantum research enterprise, stimulate the fledgling U.S. quantum computing industry, educate the future quantum computing workforce, and accelerate advancement of quantum computer capabilities. In collaboration with private sector stakeholders, the research facility user community, and interagency partners, the Department of Energy (DOE), through the Office of Science, intends to develop such a roadmap. DOE invites interested parties to provide input on the quantum systems that DOE should include in the roadmap; how the current access models can meet the needs of quantum researchers; and the appropriate timeline and sequencing for components of the roadmap.

**DATES:** Written comments and information are requested on or before [INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*].

**ADDRESSES:** DOE is using the <https://www.regulations.gov> system for the submission and posting of public comments in this proceeding. All comments in response to this RFI are therefore to be submitted electronically through <https://www.regulations.gov>, via the web form accessed by following the “Submit a Formal Comment” link near the top right of the *Federal Register* web page for this document.

**FOR FURTHER INFORMATION CONTACT:** Requests for additional information may be submitted to [Quantum-Systems-Access-RFI@science.doe.gov](mailto:Quantum-Systems-Access-RFI@science.doe.gov) or Dr. Ceren Susut, (301) 903-0366.

### SUPPLEMENTARY INFORMATION:

#### I. Background

Quantum information science (QIS) is a potentially transformative emerging field, with resulting quantum technologies having significant implications for scientific discovery as well as for our Nation’s economic prosperity and security.<sup>1</sup> Widespread access to a variety of quantum systems for research, development, testing, and evaluation is critical to continued rapid progress and competitiveness in this field and to accelerate QIS research and development. Congress, in the Joint Explanatory Statement accompanying the Energy and Water Development and Related Agencies Appropriations Act of 2021, requested DOE to “develop a roadmap to provide researchers access to quantum systems so as to enhance the U.S. quantum research enterprise, stimulate the fledgling U.S. quantum computing industry, educate the future quantum computing workforce, and accelerate advancement of quantum computer capabilities.”<sup>2</sup>

*Types of quantum systems under consideration:* DOE may consider access models for research and development (R&D) on a wide range of quantum systems. For simplicity, these systems are broadly categorized here, but many real facilities or capabilities will bridge across these flexible groups. The scope of quantum systems to be addressed in response to this RFI includes, but is not limited to:

- 1) Systems for synthesis, characterization, and fabrication – including foundries and testbeds
- 2) Sensors and measurement systems – including light-matter sensors, atomic sensors, magnetometers, clocks, detectors, and imaging systems
- 3) Networking and communication systems – including interconnects, transducers, repeaters, switches, routers, entangled nodes, encrypted systems, and network testbeds
- 4) Computers, processors, annealers, and analog simulators – including noisy intermediate-scale quantum (NISQ) and beyond-NISQ computers, emulators, conventional computing systems, hybrid systems, and computing testbeds

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<sup>1</sup> See <https://www.quantum.gov/>

<sup>2</sup> <https://docs.house.gov/billsthisweek/20201221/BILLS-116RCP68-JES-DIVISION-D.pdf>

*Existing access models and approaches, and DOE resources and programs that support R&D activities on quantum systems:* DOE utilizes a range of approaches for access to R&D systems and facilities that it supports, depending on the nature of the capability, the scope of the desired interaction, the extent and composition of the community that is interested in access, and other factors.<sup>3</sup> (Other federal agencies may employ similar and/or additional models.) Direct collaboration with DOE-supported researchers (including but not exclusively at DOE National Laboratories), which may involve indirect or direct usage of their systems and instruments, is one frequent method, and may not require specific agreements or obligations other than those applying generally to laboratory requirements. For instance, the Microsystems Engineering, Science, and Applications (MESA) facility<sup>4</sup> at Sandia National Laboratories offers advanced fabrication capabilities relevant to QIS, and Los Alamos National Laboratory provides a variety of quantum computing technologies to scientists and engineers.<sup>5</sup>

Technology transfer and collaboration mechanisms include Cooperative Research and Development Agreements (CRADAs) that formalize joint R&D efforts between federal laboratories and external-to-government partners; Strategic Partnership Projects (SPPs), in which work is done for businesses and other non-federal entities using specialized or unique facilities and/or expertise; as well as Agreements for Commercializing Technology (ACTs) and Technology Licensing Agreements, among others. Another approach used primarily for major facilities that host substantial numbers of external researchers is the user facility model, in which access is typically provided competitively via merit- and feasibility-based review.<sup>6</sup> Current and next-generation systems at DOE user facilities that enable breakthrough scientific discoveries in QIS include but are not limited to Nanoscale Science Research Centers,<sup>7</sup> High-Performance

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<sup>3</sup> <https://www.labpartnering.org/partnering>

<sup>4</sup> <https://www.sandia.gov/mesa/>

<sup>5</sup> <https://www.lanl.gov>

<sup>6</sup> <https://science.osti.gov/User-Facilities>

<sup>7</sup> <https://science.osti.gov/User-Facilities/User-Facilities-at-a-Glance/BES/Nanoscale-Science-Research-Centers>

Computing and Networking Facilities,<sup>8</sup> X-Ray Light Sources,<sup>9</sup> and Neutron Scattering Facilities.<sup>10</sup> Other programs, such as Oak Ridge National Laboratory's Quantum Computing User Program,<sup>11</sup> facilitate access to commercial quantum computing resources via merit-based review and user agreements. Additionally, DOE supports the development of quantum computing and quantum network testbeds for science. For instance, DOE quantum computing testbeds provide the research community with fully transparent access to novel quantum computing hardware.<sup>12</sup>

## **II. Questions**

Input is requested on information the Department should consider as it develops a roadmap to provide researchers access to quantum systems to enhance the U.S. quantum research enterprise, stimulate the fledgling U.S. quantum computing industry, educate the future quantum computing workforce, and accelerate advancement of quantum computer capabilities. Any information that may be business proprietary and exempt by law from public disclosure should be submitted as described in Section III. Please provide data, analysis, and/or other justification for all responses to this RFI, where applicable. DOE is interested in receiving input on the following questions:

- (i) What role, if any, should Federal agencies play in mediating, facilitating, or coordinating access to non-Federal quantum systems?
- (ii) What special considerations, if any, should be taken into account in accommodating the scientific communities served by these quantum systems?
- (iii) What quantum systems should be included in this roadmap?
- (iv) What mechanisms should be considered to assure access to quantum systems to the broadest possible user base including under-represented institutions and populations?

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<sup>8</sup> <https://science.osti.gov/User-Facilities/User-Facilities-at-a-Glance/ASCR>

<sup>9</sup> <https://science.osti.gov/User-Facilities/User-Facilities-at-a-Glance/BES/X-Ray-Light-Sources>

<sup>10</sup> <https://science.osti.gov/User-Facilities/User-Facilities-at-a-Glance/BES/Neutron-Scattering-Facilities>

<sup>11</sup> <https://www.olcf.ornl.gov/olcf-resources/compute-systems/quantum-computing-user-program/>

<sup>12</sup> <https://qscout.sandia.gov> and <https://aqt.lbl.gov>

- (v) What are the needs for user support to make effective use of access to quantum systems?
- (vi) What should be the metrics for success in an access model?
- (vii) How should software access be provided in conjunction with hardware access?
- (viii) For competitive proposals requesting access to quantum systems, what should be the criteria in the merit review process?
- (ix) What factors should be considered in adding, expanding, or reducing access to specific quantum systems as the field evolves or matures?
- (x) With respect to access to various types of quantum systems, how do near-term and longer-term priorities differ?
- (xi) What standard intellectual property (IP) provisions are needed to facilitate broad access to quantum systems for the public benefit?
- (xii) Are there other factors, issues, or opportunities, not addressed by the questions above, which should be considered in the development of such a roadmap?

Comments containing references, studies, research, and other empirical data that are not widely published should include copies of the referenced materials. Note that comments will be made publicly available as submitted. Any information that may be confidential and exempt by law from public disclosure should be submitted as described below.

### **III. Request for Information**

The Department seeks input from stakeholders to assist DOE in developing a roadmap for access to quantum systems, including the nature of quantum systems that should be considered; how the current access models can meet the needs of quantum researchers; and the appropriate timeline and sequencing for components of this roadmap. The input received will be considered by DOE in its development of the roadmap and for QIS program planning and development. Please be aware that this RFI *is not* a Funding Opportunity Announcement, a Request for Proposal, or other form of solicitation, or bid for DOE to fund potential research, development, planning, centers, or other activity.

*Confidential Business Information:* Pursuant to 10 CFR 1004.11, any person submitting information he or she believes to be confidential and exempt by law from public disclosure should submit via email: one copy of the document marked “confidential” including all the information believed to be confidential, and one copy of the document marked “non-confidential” with the information believed to be confidential deleted. DOE will make its own determination about the confidential status of the information and treat it according to its determination. Factors of interest to DOE when evaluating requests to treat submitted information as confidential include: (1) a description of the items, (2) whether and why such items are customarily treated as confidential within the industry, (3) whether the information is generally known by or available from other sources, (4) whether the information has previously been made available to others without obligation concerning confidentiality, (5) an explanation of the competitive injury to the submitting person which would result from public disclosure, (6) when such information might lose its confidential character due to the passage of time, and (7) why disclosure of the information would be contrary to the public interest.

### **Signing Authority**

This document of the Department of Energy was signed on August 11, 2021, by Harriet Kung, Deputy Director for Science Programs, Office of Science, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the *Federal Register*.

Signed in Washington, DC, on August 11, 2021.

**Treena V. Garrett,**

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*U.S. Department of Energy.*

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